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(54) **Roof climbing appliances**

(57) A board B has a layer of suitable flexible foam plastics fixed to its underside so that when placed upon a pitched roof, the frictional grip on tiled surfaces is such that it remains stationary. With suitable choice of dimensions, such a 'grip-board' will also provide stable support for considerable weights. Disclosed are:

1. A grip-board fitted with footholds, which can be used as a roof ladder or clambering board, (Fig. 2).

2. One or more grip-boards fitted with a platform, the latter so angled that it provides a horizontal working surface when the assembly is resting upon a sloping roof, (Figs. 3, 4).

3. Foot platforms, each being a miniature version of the above work platform, but employed in pairs attached to the user's feed to provide a personalised means of walking on sloping surfaces, (Fig. 5).

Fig 2

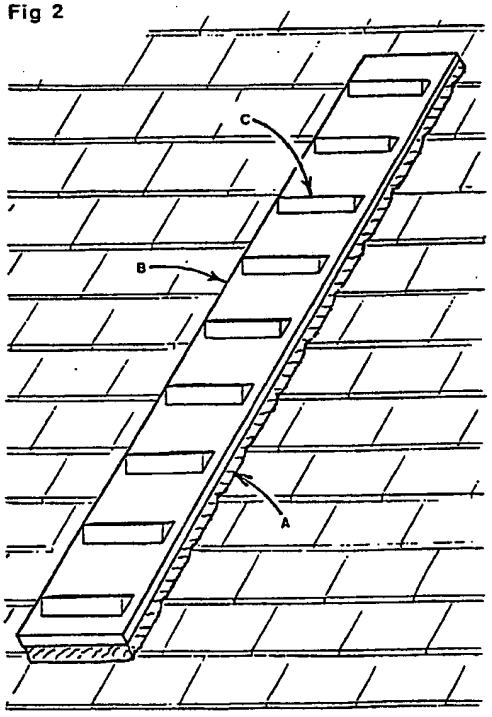

Fig 5

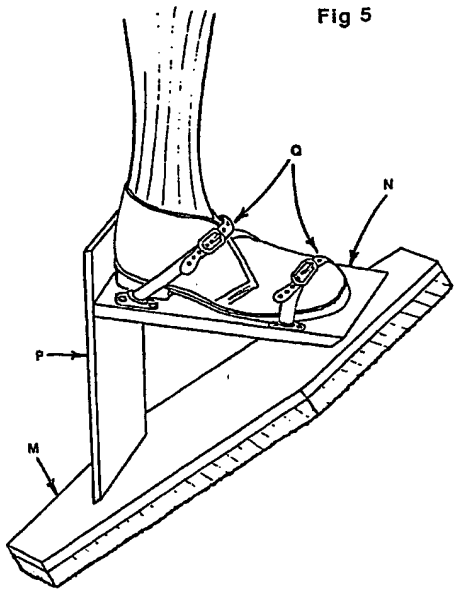

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Fig 1

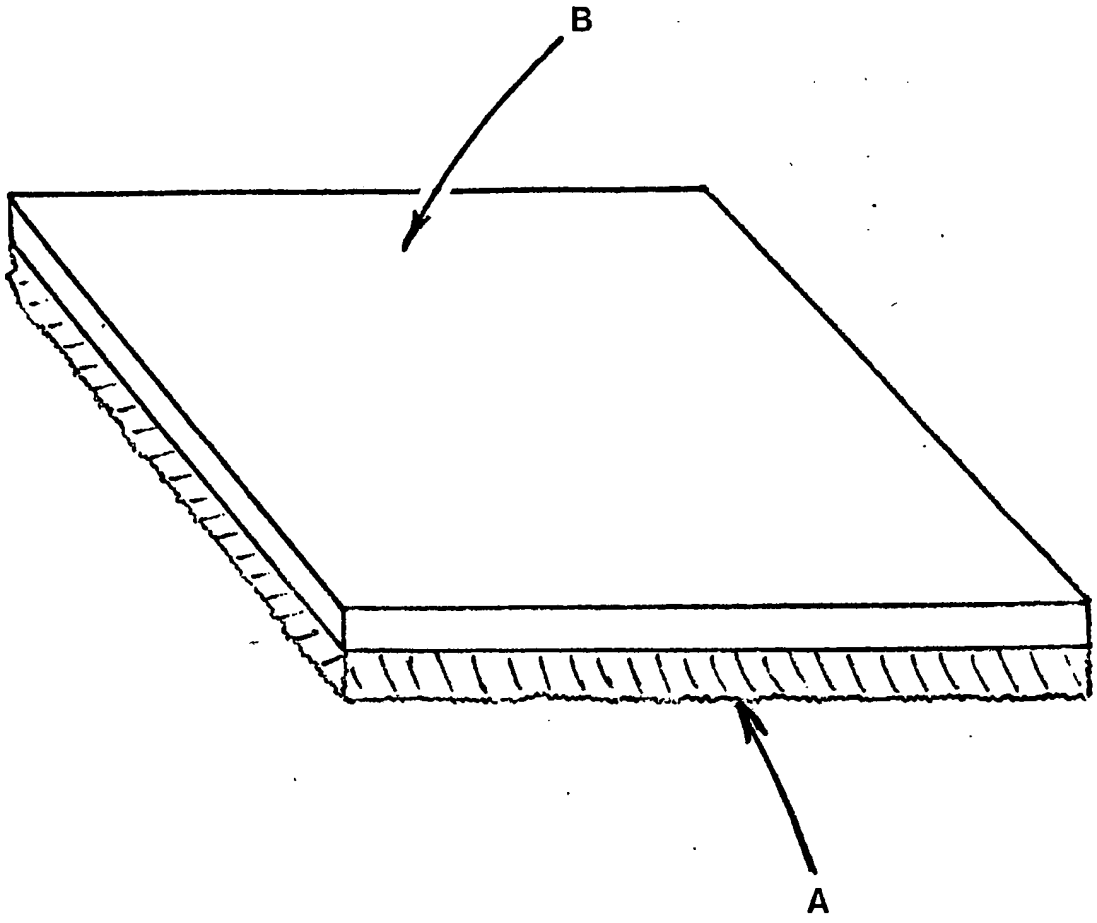


Fig 2

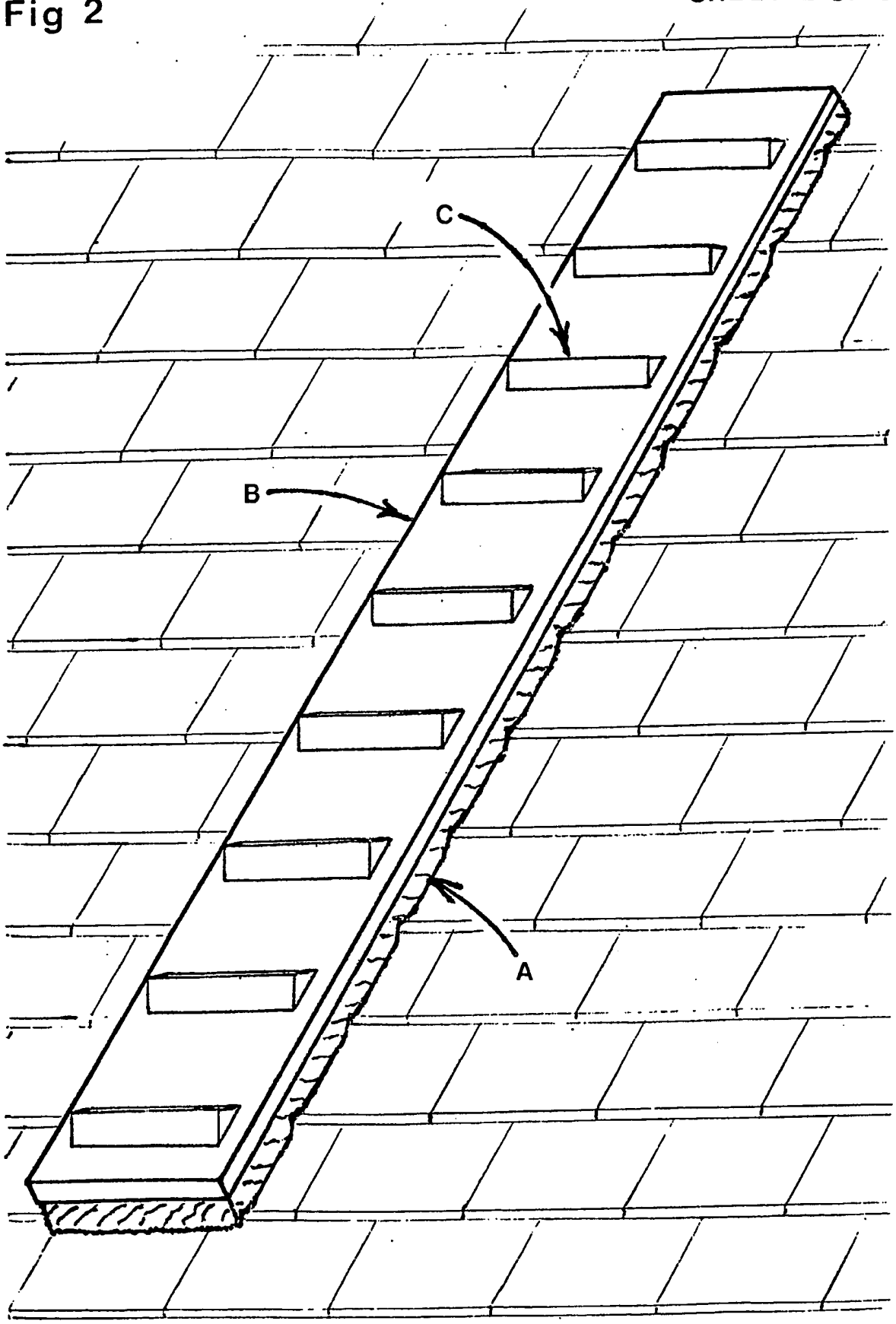


Fig 3

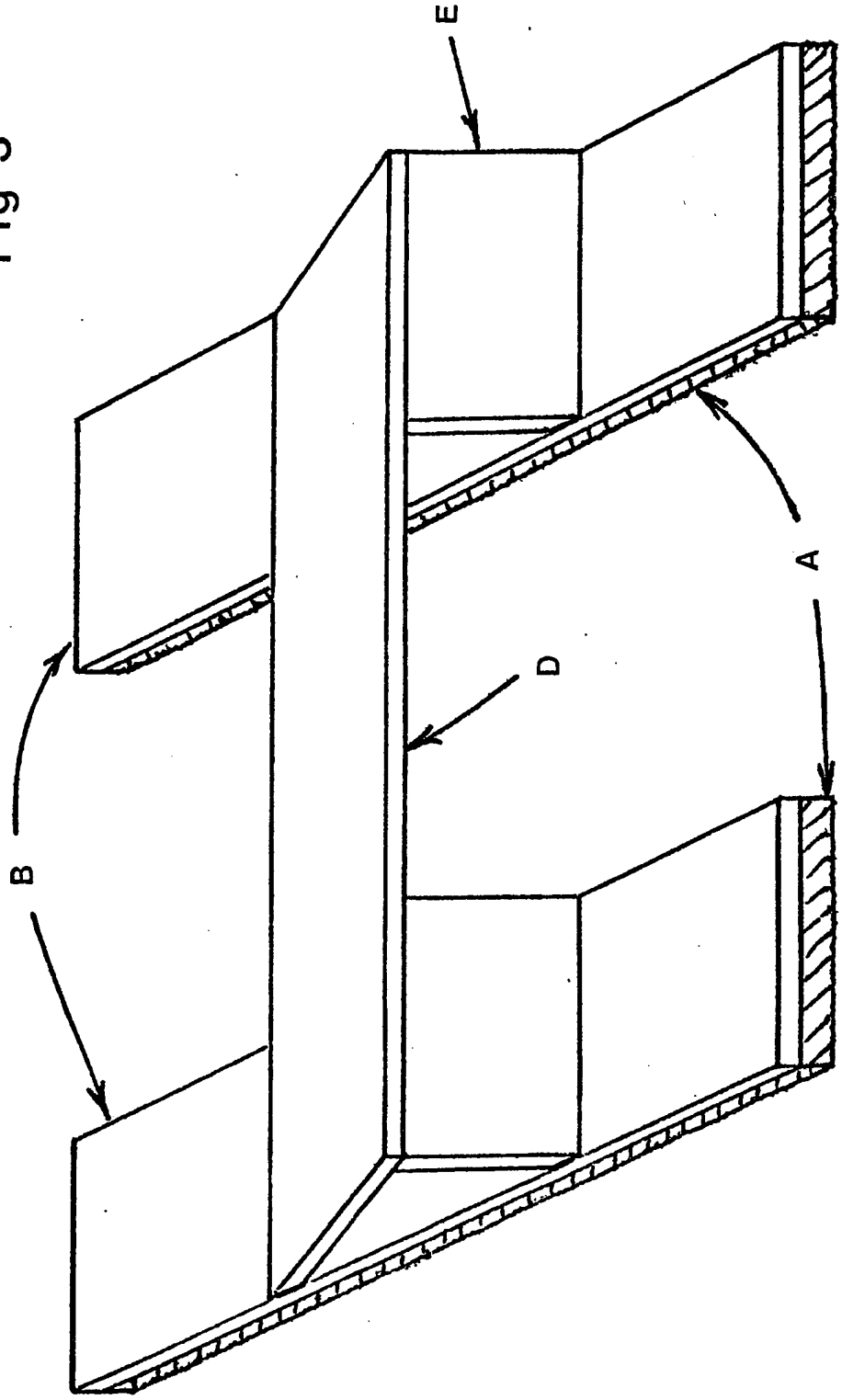


Fig 4

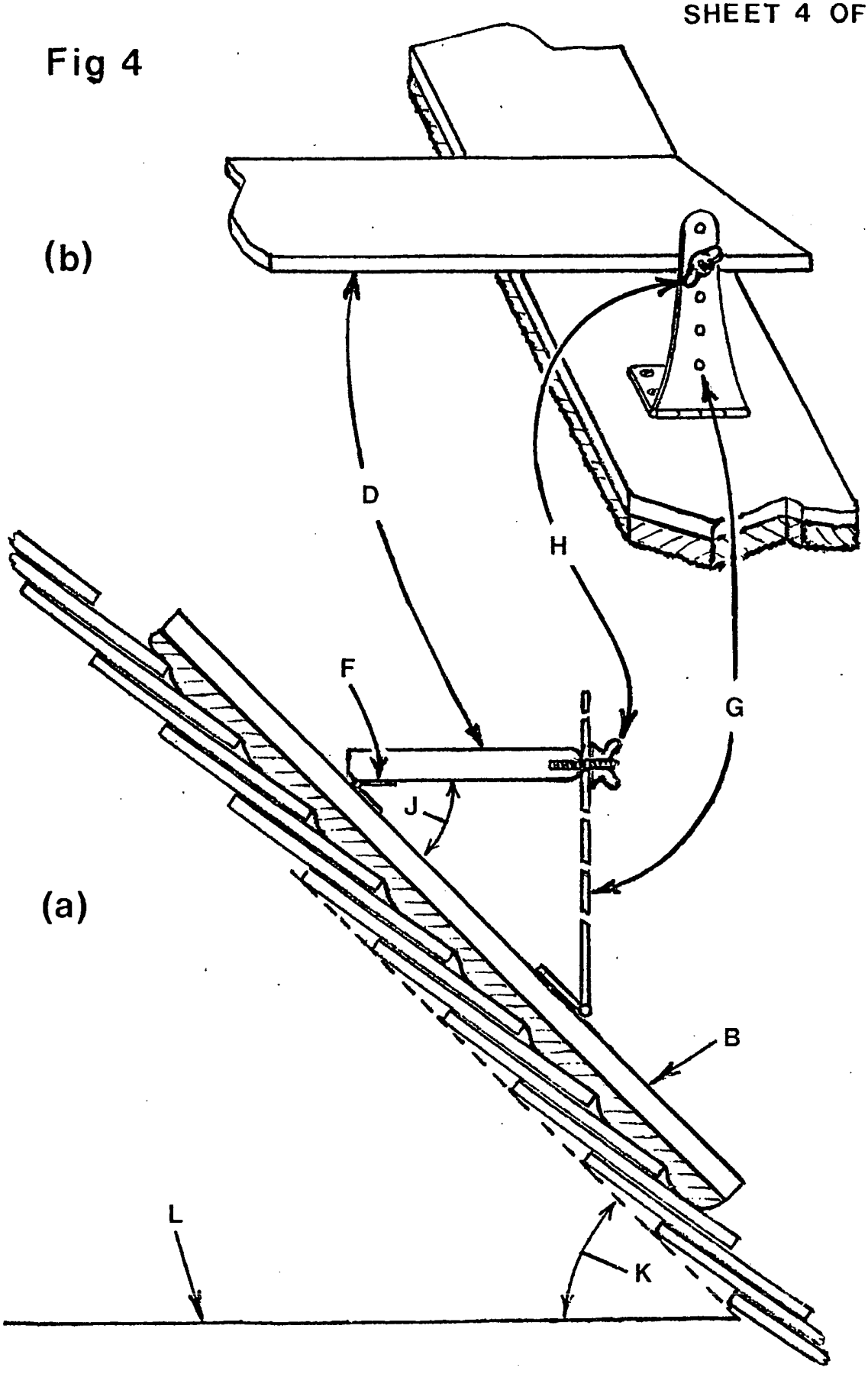
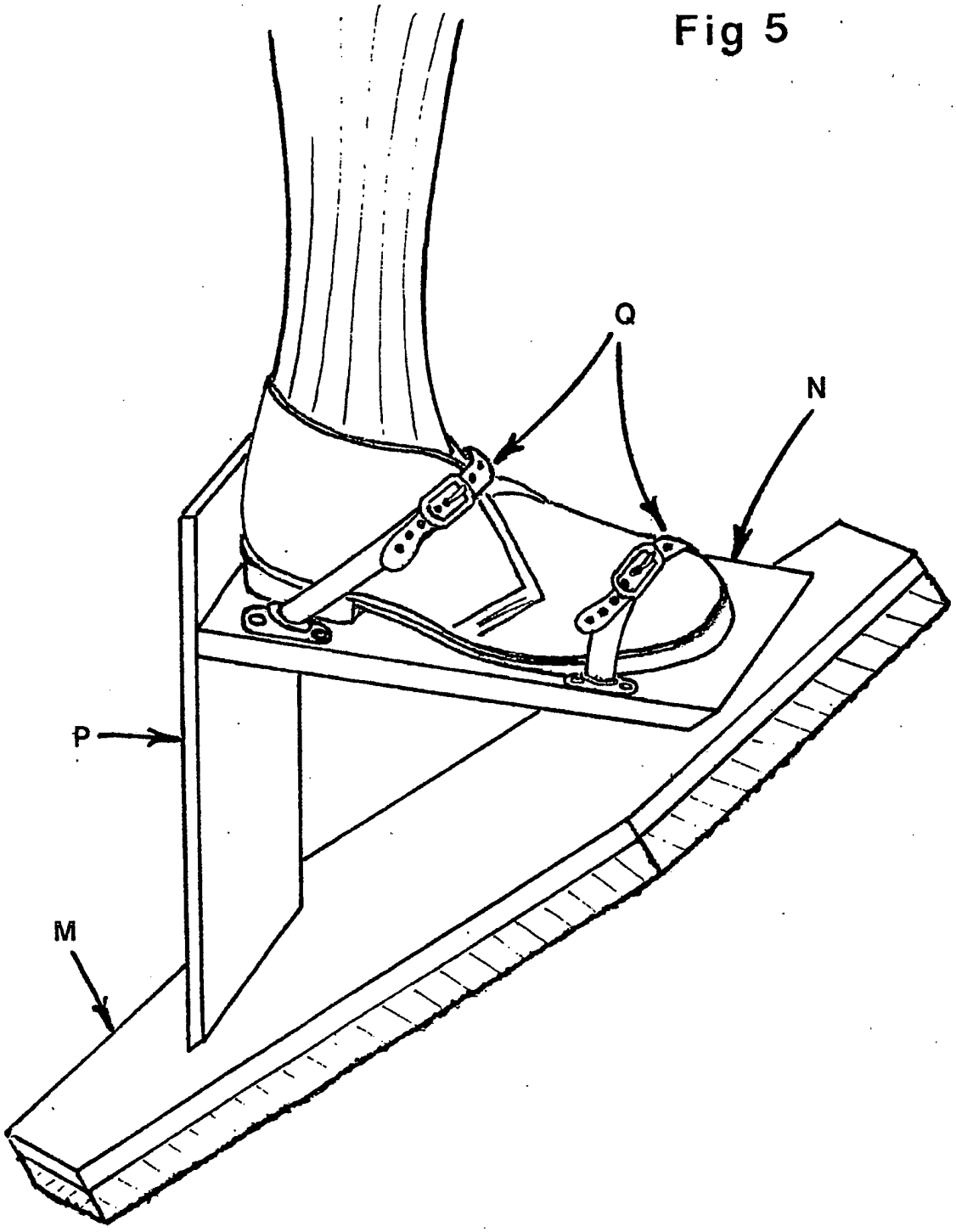


Fig 5



SPECIFICATION

Roof climbing appliances

I, Henry John Frederick Crabbe, a British subject of 66 The Glade, Shirley, Croydon, Surrey, CRO 7QD, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to appliances which enable persons to climb or work easily and safely upon sloping surfaces such as tiled roofs, with particular reference to the use of a previously unexploited property of flexible foam plastics or rubbers.

When inclined roofs have to be scaled in the course of work it is important that the operative's foothold and balance be secure and that his or her weight be so distributed that tiles are not subjected to concentrated forces which cause cracking. To this end, it is customary to employ a roofladder equipped with a grappling hook, which is placed up the slope of a roof and hooked over its apex. Alternatively, when no relevant apex is available it may be necessary to use supporting ropes slung around chimneys or other protruding structures, while clambering boards may be placed across tiles to distribute an operative's weight.

A roof-ladder is heavy and inflexible in use, while other expedients can be both risky and uncomfortable. In cases where prolonged work must be done in the middle of a tiled roof area, as for instance when building or painting a dormer window or re-pointing the brickwork of a chimney, it is usually necessary to erect scaffolding in order to provide secure horizontal surfaces from which to operate. Working on roofs is therefore inclined to be either difficult or expensive.

It is the object of the present invention to provide an inexpensive solution to these roof climbing problems. The invention relies upon the fact that if a layer of flexible foam polyurethane (or other foam plastics and rubbers having similar mechanical properties) is securely fixed to a flat rigid member, and a normal force applied to the free side of that member while the foam's other face rests on a hard mineral surface, the resulting frictional grip is very high and can be used to provide stable supports on sloping roofs.

Because of the cellular and elastic nature of flexible foam plastics and the resultant change of microscopic mechanical regime when compression is applied to their surfaces, precise measurements of friction between such foams and other materials are difficult to make. Also, some of the textbook laws of friction seem not to apply very closely when soft foams are pressed against overlapping roofing tiles. However, if frictional behaviour is examined with parameters chosen to match roof climbing operations, it is found that a rigid board with a layer of soft foam plastics glued to its underside (hereinafter called a grip-board) has remarkably useful gripping properties when placed upon a sloping tiled surface beneath the weight of a typical human male. Such a grip-board, which is the basic component of this invention, is illustrated in Figure 1. Here, a layer of flexible foam plastics A is stuck firmly to a flat board B, the foam's underside being characterised by an unsealed soft cellular structure, not the surface skin found on some foam samples.

Dependent on the compositional material of its tiles, a roof may be pitched quite steeply before slippage of such a grip-board occurs, while the above mentioned minor departures from normal frictional laws add to the invention's usefulness in three ways, as follows.

(1) Sliding friction seems not to be lower than static friction, so that a grip-board resting on a sloping surface at the critical 'angle of repose' will not slide out of control if moved accidentally, and will become completely stable if stepped upon, the latter by virtue of the next feature.

(2) There is a rise in the operative coefficient of friction if the area of contact is increased, which means that gripping action improves when additional downward force is applied to a grip-board resting on overlapped tiles. This is because: (i) surface contact increases as the foam's cellular underside is forced into more intimate microscopic contiguity with the roof material; (ii) there is improved accommodation to tile curvature; and (iii) the foam is pressed further into the right-angled channels formed where the tiles overlap.

(3) The presence of water has negligible lubricating effect in the case of clay or concrete tiles, and actually improves the grip on slate tiles, so that outdoor work is not inhibited by wet weather.

Within the constraints imposed by variations of material and shape for any one type of roofing tile, and also between samples of soft foam plastics of various densities, test-bench measurements using grip-boards resting upon tile materials have revealed the following coefficients of friction (μ): slate, $\mu = 0.7$ (0.9 when wet); smooth fire-clay, $\mu = 0.93$; slightly gritty concrete, $\mu = 1.5$. Applying the usual formula ($\mu = \text{Tan } \theta$) to obtain corresponding maximum gradients before occurrence of slippage, these coefficients give 35° (42° wet), 43° and 56° respectively. Allowing for a scatter of measurements when tiles are conventionally overlapped on battens, these angles were confirmed on a sloping roof in the cases of clay and concrete, but were significantly bettered with slate. The latter's slippage angle rose to $43\frac{1}{2}°$ ($\mu = 0.95$) when dry, and to 50° ($\mu = 1.2$) when wet. Thus in the practical roof situation grip-boards are usable at all gradients below 43°, and as most actual tiled roofing areas in the U.K. are pitched at angles of less than 40°, this imparts wide validity and usefulness to the invention.

The aforementioned measurements were conducted using polyurethane upholstery foam of 2.5 and 4.0 cm thickness. The former appears to be about optimum for nominally flat tiles, but the latter is more versatile in accommodating a range

of tile profiles. Other thicknesses and various densities of foam may be used, also alternative plastics or rubbers, while foam thicknesses of up to 5.0 cm may be needed when scaling pantiles or other deeply ribbed surfaces. However, caution should be exercised in the use of thicker foams, which tend to feel less stable in use due to the accompanying increased lateral compliance of the grip-board system. To facilitate usage on a wide variety of roofing surfaces, it could be advantageous for a manufacturer to provide user-replaceable foams of various thicknesses and/or densities.

The rigid members of grip-boards used for measurements and experiments comprised flat planks of 2.0 cm thick timber of around 3000 sq.cm total area for a one-man load, but various shapes and areas of any suitably rigid material could be employed, whether wood, wood-composite, metal, fibreglass or rigid plastics. Also, it might be feasible for a manufacturer with special plastics expertise to produce a one-piece grip-board by providing a continuum of material with varying density and compliance, from the soft cellular foam underside at one extreme to the rigid upper surface at the other.

Drawing upon the foregoing findings and suggestions, roof climbing aids of various types may be produced, using grip-boards as defined and described above, and as illustrated in the simplest form in Figure 1. Some preferred embodiments of the invention are described in the following, with reference to the accompanying drawings labelled Figures 2, 3, 4 and 5. These embodiments comprise ribbed ladder-boards, fixed and adjustable work-platforms, and pairs of foot-platforms.

Figure 2 is a perspective view of a ladder type grip-board lying up the slope of a tiled roof. The foam layer A and rigid member B are as already illustrated in Figure 1, but the board here has an extended length suiting it to the rapid scaling of roofs, with rigid cross-bars C added to provide suitable footholds. Two such ribbed ladder-boards used as a pair enable an operator to move up, down or across a roof with ease and rapidity, one board being carried whilst moving along the other, the hand-held one then being placed down for the next stage of movement, and so on.

Figure 3 is a perspective view of a work-platform, comprising two grip-boards A/B linked by a cross-member D. This may be placed on a roof adjacent to a working area, providing a stable horizontal surface from which a person can perform tasks such as painting. In this version the horizontal board D is attached directly to the two grip-boards at its front edge, and via the vertical members E at its rear edge, the fixed angle thus formed being chosen as a compromise to suit a practical range of roof inclinations. The total foam area of such a system could conveniently fall in the region of 3000 sq.cm, such a figure facilitating the use of grip-boards with a width greater than that of one roofing tile and a length providing adequate support and stability for a platform of practical working length (e.g. 1 metre). Such dimensions also limit the overall weight, permitting a complete work-platform to be carried up a ladder and handled by one person.

When spacing and sizing the two 'feet' of a work-platform it is important not only to provide stable contact across at least one tile width per grip-board, but also to position, shape and size the two boards such that one cannot sit lower than the other on a roof, or apply all its pressure to a single rib when used on deeply undulating tiles. For this and related reasons, or to support an especially long or wide working surface, it may be useful in some versions to employ more than two grip-boards, or perhaps a single large board in the shape of a circular or elliptical band whose outer limits encompass the horizontal platform's largest dimension.

Figure 4(a) shows a cross-sectional view of one of the grip-boards B of a work-platform, resting here on a tiled roof. It also illustrates one possible way in which the platform member D could be made adjustable so as to keep it approximately horizontal in the fore-and-aft direction over a range of roof inclinations. In this version the horizontal member is hinged at F, where its front edge meets the two grip-boards, while a hinged bar G provides vertical support at the rear edge. Each of these bars G, one of which is also shown in the perspective drawing Figure 4(b), carries a line of holes to accommodate a bolt protruding from the platform member's rear edge, to which it is locked by means of a wing-nut H once a suitable angle J has been chosen. Ideally, this angle would be the same as that of the roof's slope K above the horizontal L. Other ways of pre-setting this platform angle could be devised, and all such means are subsumed here under the general concept of an adjustable version of the work-platform system.

Figure 5 is a perspective view of a foot-platform, a pair of which may be used to provide a personalised means of moving across or standing upon sloping roof surfaces without the need to lift or manoeuvre separate devices. Here, the smallest practicable grip-board M, which experiments indicate would be around 800 sq.cm in area for each supported foot, carries a horizontal platform member N with a supporting back-plate P. The small platform is equipped with means Q for locating and firmly gripping the user's foot, but such means may take various forms beyond the simple straps illustrated. An alternative option for a manufacturer of foot-platforms would be to provide a set of fixing bolts whereby a pair of discarded boots or shoes could be secured to the platforms by their soles. Also, some means of adjusting the platform angle to suit various roof slopes could be incorporated.

As with the other embodiments of the invention described in this Specification, dimensions, shapes, materials and supporting fitments may all be varied according to circumstances and convenience while still remaining within the

invention's scope, which is to employ grip-boards in various guises as aids to climbing or working upon roofs.

CLAIMS

1. Layered structures, conveniently called 'grip-boards', featuring a firm upper surface and an underside comprising a depth of flexible urethane foam, or other foam plastics, foam rubbers, or materials with similar mechanical properties, these structures having areas, shapes, thicknesses, and class and grade of foam, such that when placed foam-side downwards on a sloping roof the frictional grip is sufficient for the grip-board to support whatever weight may be designated, up to that of one or more human beings, without slippage down the roof's slope, this weight being so distributed across the area of contact that there is minimal risk of damage to tiles or other brittle surfacings.

2. A grip-board according to claim 1, having on its upper surface a series of bars or other secure protrusions so shaped and positioned as to provide footholds, permitting the device to be used as a self-supporting ladder or clambering board when placed on a sloping roof surface.

3. A grip-board or boards according to claim 1, fitted with a superstructure comprising a platform with supporting members, possibly of one-piece construction, the platform having an upper surface which is horizontal along its lateral axis and approximately horizontal along its fore-and-aft axis when the associated grip-board(s) is (are) resting on a typical sloping roof, in order to provide a level working surface on which a person or persons can stand, or building materials be stood, when the appliance is placed upon such a roof.

4. A work platform according to claim 3, where the supporting members linking platform to grip-board(s) are adjustable so as to maintain horizontality along the platform's fore-and-aft axis over a range of roof pitches.

5. A pair of grip-boards according to claim 1, each fitted with a miniature version of the superstructure described in claim 3, the platform of said superstructure being equipped with the means to clamp or otherwise securely hold a shoe or boot, or integrally containing or comprising such footwear, so that a user may fit the two appliances to his feet in order to walk or stand upon a sloping roof while keeping his feet horizontal.

6. A pair of foot platforms according to claim 5, equipped with means for adjusting and locking the fore-and-aft angle as in claim 4.

7. A pair of foot platforms according to claims 5 or 6, with provision for rotating the horizontal member, or suitable part thereof or footwear attachment thereto, laterally through an angle of 180 degrees so that the user may face either up or down a roof's slope when walking or standing.

8. Grip-boards, ladder boards, work platforms and foot platforms as hereinbefore described with general reference to the drawings labelled Figures 1, 2, 3 and 5 accompanying the Specification.

Superseded claims 2, 7
New or amended claims:—

2. A grip-board according to claim 1, having on its upper surface a series of bars or other secure protrusions so shaped and positioned as to provide footholds, permitting the device to be used as a self-supporting ladder or clambering board when placed on a sloping roof, or grip-boards fixed to a runged ladder to afford the same facility.

7. A pair of foot platforms according to claims 5 or 6, with provision for rotating the platform member, or suitable part thereof or footwear attachment thereto, horizontally through an angle of 180 degrees so that the user may face either up or down a roof's slope when walking or standing.

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DERWENT-WEEK: 198425

TITLE: Grip board for working on sloping roof has firm upper surface and underlayer of foamed polyurethane or rubber

INVENTOR: CRABBE H J F

PATENT-ASSIGNEE: CRABBE H J F[CRABI]

PRIORITY-DATA: 1982GB-035220 (December 10, 1982)

PATENT-FAMILY:

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APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
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CIPS	E04D15/00	20060101
CIPS	E04G3/26	20060101
CIPS	E06C7/08	20060101

ABSTRACTED-PUB-NO: GB 2131475 A

BASIC-ABSTRACT:

A board for placing on a sloping roof to support a person without **slipping** and without damaging the roof comprises has a firm upper surface and a lower layer of flexible foamed **polyurethane, rubber or other elastomer**. The board is placed with the foam on the roof to provide a frictional grip.

The upper surface pref. carries a spaced transverse bars or other protrusions so that the board can be used as a ladder. Alternatively, the two-layer board material can be placed on the rungs of a ladder, can be used for a work platform, or can be secured under footwear so that the user can walk up or down a roof. When used with footwear, each board is pref. adjustable and lockable over a range of fore-and-aft angles so that the user may face up or down a roof walking or standing.